03M06A78

Operating and Service Manual

OS255 15MHz
DUAL TRACE
OSCILLOSCOPE
INSTRUCTION MANUAL

GOULD

An Electrical/Electronics Company

GOULD

MANUAL PART NO.
80-OS255A

OS255 15MHz DUAL TRACE OSCILLOSCOPE INSTRUCTION MANUAL

The information contained herein is the exclusive property of Gould Inc., except as otherwise indicated and shall not be reproduced, in whole or in part, without explicit written authorization from the company. The distribution of this material outside the company may occur only as authorized by the company in writing.

Additional copies of this publication may be ordered by contacting your local Gould representative.

All information contained in this manual is the latest product information available at the time of printing. The right is reserved to make changes at any time without notice.

PRINTED 2-80
COPYRIGHT 1978

Gould Inc., Instruments Division
3631 Perkins Avenue, Cleveland, Ohio 44114

5th PRINTING
PRINTED IN U.S.A.

Contents

SECTION	1	**Introduction**	3
SECTION	2	**Specification**	4
SECTION	3	**Operation**	5
	3.1	Connection to the supply	5
	3.2	Obtaining a Trace	5
	3.3	Setting up the Y channels	5
	3.4	Display Modes	5
	3.5	Timebase and X Expansion	6
	3.6	Trigger	6
	3.7	Additional Facilities	6
SECTION	4	**Circuit Description**	8
	4.1	General	8
	4.2	The Y Amplifier and Beam Switch	8
	4.3	The Trigger Circuits	10
	4.4	The Timebase Generator and X amplifier	10
	4.5	The Mode Control Circuits and Calibrator	11
	4.6	The Power Supplies and C.R.T. Circuits	12
SECTION	5	**Maintenance**	14
	5.1	General	14
	5.2	Access	14
	5.3	Fault Finding	14
	5.4	Setting-up Procedure	16
SECTION	6	**Component Lists and Circuit Diagrams**	
SECTION	7	**Guarantee and Service Facilities**	

ILLUSTRATIONS

Fig.	1	Block Diagram	9
Fig.	2	Internal Assembly – top view	18
Fig.	3	Internal Assembly – bottom view	19
Fig.	4	Circuit Diagram, Y Amplifier	27
Fig.	5	Circuit Diagram, X Circuits	28
Fig.	6	Circuit Diagram, Power Supply and C.R.T. Circuits	29
Fig.	7	Mechanical Views	31

Specification

Section 2

DISPLAY
8 x 10cm rectangular mono-accelerator c.r.t. at 2kV
Trace Rotation by front panel preset.

VERTICAL DEFLECTION
Two identical input channels CH1 and CH2
Bandwidth (−3dB)
d.c. to 15MHz (2Hz to 15MHz on a.c.)
Sensitivity 2mV/cm to 10V/cm in 1−2−5 sequence.
Accuracy ±5%
Variable Sensitivity >2.5:1 range allows continuous adjustment of sensitivity from 2mV/cm to 25V/cm.
Input Impedance 1MΩ/28pF approx.
Input Coupling DC-GND-AC
Input Protection 400V d.c. or pk a.c.

DISPLAY MODES
Single Trace CH1 or CH2
Dual Trace Chopped or Alternate modes automatically selected by the T.B. switch between 0.5 and 0.2ms/cm. Chop Freq. 500kHz.
Add CH1 and CH2 added to give the albebraic sum of the two channels.
Invert CH2 CH2 may be inverted. When used in conjunction with Add mode it gives the albebraic difference of the two channels.
X - Y CH1 input gives Y deflection and CH2 input gives X deflection.
Bandwidth (−3dB) DC to 1MHz with less than 3° phase shift at 50kHz.

HORIZONTAL DEFLECTION
Timebase 0.5μs/cm to 0.2sec/cm, 18 ranges in 1−2−5 sequence.
Accuracy ±5%
X Expansion X5 push button gives fastest speed of 100ns/cm, with no loss of accuracy.
Variable Sweep >2.5:1 allows continuous coverage from 0.5μs/cm to 0.5sec/cm.

TRIGGER
Variable level control with Bright Line ON/OFF facility with < Bright Line on, the timebase free-runs when insufficient signal (less than 40Hz) is present or when the selected level is outside the range of the input signal.
Source Internal CH1 or CH2 or External.
Slope + or −
Coupling DC, AC or TV (active sync. separator with line/field selected by T.B. switch between 50 and 100μs/cm)
Sensitivity Internal, 2mm to 2MHz, 1cm at 15MHz
External, 0.25V to 2MHz, 1.25V at 15MHz on A.C. 10Hz to 2MHz, Int. 2mm, Ext. 0.25V, 2Hz to 15MHz, Int. 1cm, Ext. 1.25V on T.V., Synch pulse amplitude, Int. 2mm, Ext. 0.25V
External Input Impedance 100kΩ/10pF approx.
External Input Protection 250V d.c. or pk, a.c.

ADDITIONAL FACILITIES
Calibrator 1V, 2% squarewave at approx. 1kHz
Ramp Output Approx. +3.5V ramp from 5kΩ
Z Mod. Input DC coupled, 2V visible mod. sensitivity, +40V cut-off sensitivity, input impedance 10kΩ/10pF approx.

POWER
100V, 120V, 220V and 240V ± 10%
45 to 440Hz, approx. 40VA.

SAFETY
Designed for I.E.C.348 Cat. 1.

OPERATING TEMPERATURE RANGE
0 to +50°C (+15 to +35°C for full accuracy)

DIMENSIONS
5¼" x 12" x 16½"

WEIGHT
15 lbs.

ACCESSORIES SUPPLIED
Manual Part No. 80-OS255A
Power Cord PL98
BNC to Clip lead PL44 (2 off)
4mm plug (2 off)
2 PB13 Probe Kits with X10 Attenuator

OPTIONAL ACCESSORIES
Probe Kit PB12
A passive probe kit with switched X1 and X10 attenuations. X10 attenuation input impedance is 10MΩ/11.5pF.

Viewing Hood
P.N. 41179.
Carts
Types TR4 and TR6. General purpose.
Protective Carrying Case
P.N. 40838. A strong case which completely encloses the oscilloscope with 3 thicknesses of padding covering the front panel.
Tube Option
Long persistance C.R.T. P7 phosphor.
Rack Mount Kit
P.N. 41180.
Front Cover
P.N. 41178.

CAUTION:
The OS255 relies on convection cooling and must not be operated in a position which restricts the external circulation of air.

3.1 CONNECTION TO THE SUPPLY

1. Before connecting the OS255 to the supply, check that the supply range switches are set to suit the supply voltage to be used and that the correct fuse is fitted. Note that the fuse has to be changed when switching between the 100V and 220V ranges. The switches and fuse holder are mounted on the back panel of the instrument. Do not operate the range selection switches while the OS255 is switched on.

SAFETY: The OS255 is designed to be used with the frame grounded and it is important that the green lead of the Power Cord, PL98, is connected to a suitable ground.

3.2 OBTAINING A TRACE

1. After connection to the supply, switch on by turning the INTENSITY control clockwise away from the OFF position. Check that the adjacent indicator lamp lights.
2. Set the CH1 MODE switch to CH1
   CH1 Y shift control (vert. arrows) to approx. mid setting.
   CH1 VAR SENS control full clockwise to the CAL position.
   CH1 input coupling switch to GND.
   BRIGHT LINE button out (ON)
   X MAG. button out (X1)
   X shift control (horiz. arrows) to approx. mid setting
   TIME/CM switch to 5μs
   A horizontal trace should appear on the screen as the INTENSITY control is advanced.
3. Adjust the INTENSITY control to obtain a display of the required brightness.
4. Adjust the FOCUS control to obtain a sharply defined trace.
5. Adjust the CH1 Y shift control and the X shift control to centralise the trace on the screen.
6. Adjust the TRACE ROTATE preset control if necessary to align the trace with the centre graticule line. It may be necessary to re-adjust this control only when the instrument is re-positioned as the beam deflection can be affected by earths magnetic field or other sources of magnetic radiation.

NOTE: The OS255 should not be operated close to sources of alternating magnetic field such as large transformers as these may interfere with the trace.

3.3 SETTING UP Y CHANNELS

1. Using a coaxial input signal lead, connect a signal to the CH1 or CH2 input socket.
2. For
   (a) Direct connection of the input signal, set the associated AC-Ground-DC slide switch to DC.
   (b) Capacitive coupling of the input signal through an internal 0.1μF 400V capacitor, set the slide switch to AC.

NOTE: When examining low amplitude a.c. signals superimposed on a high d.c. level, the slide switch should be set to AC and the sensitivity of the Y amplifier increased as in (4).

3. To locate the base line, set the slide switch to the GND setting. At this setting, the input signal is open circuit and the input to the amplifier is connected to ground.
4. To select sensitivity, set the VOLTS/CM switch to the required range. For calibrated operation, the VARiable SENSitivity control should be set fully clockwise to the CAL position. This control can be used however to reduce the gain of the relevant amplifier and obtain any intermediate sensitivity between the calibrated switched ranges. To set to any particular calibrated sensitivity, the actual variation from the calibrated range can be set by viewing the CAL input on the 0.1V/cm or 0.2V/cm ranges. If the VAR SENS control is not moved, the sensitivity will differ from the calibrated value by approximately the same proportion on all settings of the VOLTS/CM switch.

   To minimise pick-up at sensitive settings, it is essential to ensure that the ground lead connection is near to the signal point.
5. For vertical movement of the trace, adjust the Y shift controls (identified by the vertical arrows).
6. Any trace movement under no-signal conditions, when the setting of the VOLTS/DIV switch is altered, can be overcome by adjustment of the preset front panel balance control.

   This control will only need adjustment at infrequent intervals. Before adjusting the BAL control however, ensure that the input coupling switch is set to GND. No adjustment should be made until a minimum of 15 min. warm-up time has elapsed after switch-on, or immediately after any large change of ambient temperature.

3.4 DISPLAY MODES

The MODE switch determines the form of the display.

1. For single trace display of one Y input against the timebase this switch should be set to CH1 or CH2 and the input signal applied to the appropriate input connector.
2. For dual trace simultaneous display of both Y inputs against the timebase, this switch should be set to DUAL. Two modes of beam switching are used and selected automatically by the sweep rate selected by the TIME/CM switch. The alternate mode is used at fast sweep rates between 0.2ms/cm and 0.5μs/cm. At

the slower rates from 0.2s/cm to 0.5ms/cm the chop mode operates at approx. 500KHz.

3. In the ADD mode, the single trace generated against the timebase is the algebraic sum of the CH1 and CH2 deflections.

   If the INV CH2 button is operated in the CH2 DUAL, or ADD modes, the direction of Y deflection for that channel is reversed. If used in the ADD mode, this facility allows the difference between the CH1 and CH2 inputs to be displayed. The INV CH2 button is inoperative in the X-Y mode and it has no effect on internal CH2 trigger.

   When examining small difference between large signals, the effect of small errors between the sensitivities of the two channels can be overcome by first connecting one input to both channels and adjusting one or other of the VARiable SENSitivity controls to obtain a straight line.

NOTE: On early production instruments a small amount of interference may appear on the X deflection unless the trigger level control is offset to either end or unless external trigger is selected.

4. In the X-Y mode, the timebase is disabled and the CH1 inputs is displayed as the vertical Y deflection against the CH2 input displayed as horizontal, X deflection. The CH2 shift control is inoperative and X position is determined only by the X shift control. The X5 MAG facility is also inoperative, X deflection sensitivity being determined by the CH2 controls only. The X bandwidth is limited to 1MHz and relative phase shift between X and Y deflections may exceed 3° above 50KHz.

3.5 TIMEBASE AND X EXPANSION

The sweep speed of the internal timebase is determined by the setting of the TIME/CM switch. The VARiable SWEEP speed control should be set fully clockwise in the CAL position for calibrated operation of the timebase. This control is used to slow the sweep rate to obtain any intermediate sweep rate, between the calibrated ranges.

For horizontal shift of the trace, adjust the X shift control (horizontal arrows). If close examination of any portion of the trace is required, X5 expansion can be introduced by operation of the MAG button. This provides an effective trace length of 50cm and any portion of this may be selected for viewing on the screen by operation of the X shift control.

3.6 TRIGGER

The timebase may be triggered internally from the CH1 or CH2 signals by operation of the corresponding TRIGGER button, irrespective of whether the selected channel is being displayed. Alternatively, the timebase may be triggered from an external signal applied to the EXT TRIG socket when both CH1 and CH2 buttons are operated simultaneously.

Trigger will occur at a level on the signal which may be set by the TRIG LEVEL control with the slope determined by the ± button. When this button is out, it will occur on a positive-going transition of the signal through the trigger level. When it is pushed in, trigger will occur on the negative-going transition. Normally triggering can be obtained from internal deflection signals greater than 2mm pk/pk up to about 2MHz but the sensitivity reduces to about 1cm pk/pk at 15MHz. Corresponding external sensitivity is 0.25V pk/pk to 2MHz and 1.25V pk/pk at 15MHz.

With A.C. coupling, the low frequency sensitivity reduces to 1 cm pk/pk or 1.25V pk/pk at about 2Hz.

The Ext Trig input impedance is approx. 100k/10pF and care should be taken not to apply more than 250V d.c. pk to this socket.

When the BRIGHT LINE button is out or ON, the timebase will free run in the absence of a correct trigger signal, to display a bright line or unsynchronised display until the level control is adjusted and/or the amplitude of the trigger signal is increased. This free-run action in the absence of correct trigger, helps in finding the trace and leads to ease of operation. If the timebase is required to free-run continuously, the LEVEL control should be set to either end of its rotation.

It is expected that the BRIGHT-LINE OFF mode will be selected only when the instrument is to be used to display signals at repetition rates less than 40 HZ. This will prevent additional free run sweeps from occurring between correctly triggered low frequency sweeps or erratic high frequency operation.

The coupling of the trigger signal may be selected as A.C. or D.C. by operation of the corresponding TRIGGER button. When both are pressed, an active synch. separator circuit is introduced to provide line or frame triggering for video waveforms. Field trigger occurs at slow sweep rates up to 100μs/cm and line trigger is automatically selected on fast sweep rates from 50μs/cm. The trigger polarity should be selected for the polarity of the synch. pulses. At lease 2mm pk/pk of synch. pulse amplitude is required with internal triggering or 0.25V with external.

Summarising the use of the trigger controls for most applications:

a) With BRIGHT LINE ON (button out), select the trigger source CH1, CH2 or EXT and the coupling required, A.C. or D.C.

b) Select the trigger slope + or – and adjust the trigger level control to obtain a stable trace, starting at the required point on the waveform.

3.7 ADDITIONAL FACILITIES

1. Calibrator

   This output pin on the front panel provides a positive going 1V flat topped square wave at approx. 1kHz. It can be used to check the sensitivity of the instrument or to set to any particular calibrated sensitivity (see section 3.3.4). The rise time is approx. 2μs and the output impedance is approx. 470Ω, providing approx. 2.3mA when shorted to ground.

   The CAL output may be used also to set up passive probes (see section 3.7.4).

2. Ramp Output
   This 4mm socket on the front panel provides a D.C. coupled positive-going ramp generated by the timebase of approx. +3.5V pk from an impedance of approx. 5k ohms. If a lower output level can be tolerated, distortion of fast ramp output signals due to capacitive loading can be avoided by adding resistive loading to attenuate the signal.

3. Z mod
   This socket on the rear panel allows modulation of the brightness. The input is D.C. coupled into approx. 10kΩ/10pF. The sensitivity at normal brightness settings requires about 2V to provide visible modulation. Approx. +40V is required to provide full trace blanking.

   Care should be taken not to apply more than 100V pk to this socket.

4. Use of the Passive Probe
   A X10 passive probe may be used to extend the voltage range and increase the input impedance of the Y amplifiers. The input resistance of a Y channel is 1M ohm, shunted by approximately 28pF. The effective capacitance of the input lead must be added to this and the resultant impedance can often load the signal source. Therefore it is advisable to use a 10M ohm, X10 probe such as PB12 or PB13. This reduces the input capacitance and increases the input resistance, at the expense of a 10X reduction in sensitivity. The probe inserts a shunt RC network in series to form a 10:1 attenuator with the input RC of the Y channel. To obtain a flat frequency response it is necessary to adjust the capacitance of the probe to match the input capacitance of the Y channel as follows:
   1. Set the Y channel VOLTS/CM switch to 20mV, the TIME/CM switch to 500μs and trigger from the appropriate channel.
   2. Connect the probe to the CAL socket.
   3. Adjust the probe compensation to obtain a level trace, i.e. flat top without overshoot or undershoot.

5. Camera
   A camera may be used with the oscilloscope to record waveforms. This facility is particularly useful at slow timebase sweep rates. Suitable cameras utilising Polaroid film may be obtained from Gould and hand held against the tube face. Other oscilloscope cameras may be used but suitable adaptors must be obtained and should be discussed with the camera manufacturer.

To aid component location, circuit references have been allocated in the following general pattern.

1 – 99	Components not mounted on printed circuit boards.
100 – 199	Components mounted on the attenuator assemblies.
200 – 299	Pre-amplifier and Ramp Generator components mounted on the daughter board.
300 – 399	Y Pre-amplifier and Beam Switch components mounted on the main board.
400 – 499	Y Amplifier and Y Output Amplifier components mounted on the main board.
500 – 599	Timebase and X Output Amplifier components mounted on the main board.
600 – 699	Trigger Circuit components mounted on the main board.
700 – 799	Power Supply and Modulation Circuit components on the main board.

4.1 GENERAL

Referring to the block diagram (Fig. 1) signals applied to the CH1 and CH2 input sockets pass into their respective attenuators and amplifiers. The VOLTS/CM switch controls the gain of the pre-amplifier in steps of 1.2.5 sequence to cover the ranges from 2mV/cm to 0.1V/cm and a ÷100 attenuator is introduced before the amplifier on the ranges 0.2V/cm to 10V/cm

The Variable Gain control adjusts the amplifier gain to give 1 to 2.5 times reduction of gain on all settings of the Volts/cm switch. The fast electronic beam switch selects either the CH1 or the CH2 signal to be amplified further and passed to the Y deflection plates of the c.r.t.

A sample of each signal is taken and passed to the trigger switch bank where selection of CH1, CH2 or Ext trig source is made.

The selected signal is amplified and passed to the Schmitt trigger, the output of which clocks the timebase bistable "on". The ramp generator then begins to generate its linear ramp, which, after passing through the X amplifier, is applied to X deflection plates of the c.r.t. and drives the electron beam linearly across the tube face. A portion of the signal from the ramp generator is fed back to the hold-off circuit, shutting the gate to prevent any further pulses from the Schmitt trigger from reaching the timebase bistable during the ramp period. When the ramp has reached the necessary maximum level, the timebase bistable is reset, and the ramp is quickly returned to its quiescent state. A time-constant in the hold-off circuit retains this signal to inhibit another ramp from being initiated for a short period, until the ramp timing capacitor is discharged fully. Thus a ramp is generated at a rate set by the TIME/CM switch when the trigger signal reaches a predetermined level. This ramp sweeps the beam across the c.r.t. face, returns and waits for the next trigger point to be reached. The timebase bistable is connected to a blanking amplifier whose function is to turn on the electron beam during the sweep and blank it off during the fly-back and subsequent waiting period.

At fast sweep rates for a dual trace display, the TIME/CM switch automatically selects the alternate sweep mode of control for the beam switch. At the end of each sweep, the signal from the timebase bistable reverses the state of the beam switch bistable, causing alternate displays of the CH1 and CH2 signal on successive sweeps of the timebase. At slow sweep rates, the chop mode is selected, when the chop multivibrator free runs independently, causing the beam to switch on chop between CH1 and CH2 levels during the sweep.

A signal from the multivibrator also blanks the trace during each switching transition. With CH1 or CH2 only selected, the beam switch bistable is held to select that channel only. In the X-Y mode, the bistable is held to select CH1 as the Y deflection signal, while an additional switch diverts the output from the CH2 pre-amplifier, to the X output amplifier as the X deflection signal in place of the normal ramp signal. The blanking amplifier is held in the bright-up state. When TV trigger mode is selected, an additional synch. separator circuit is introduced into the signal path leading into the trigger amplifier.

4.2 THE Y AMPLIFIERS AND BEAM SWITCH

These circuits are shown in Fig. 2.

The attenuators and pre-amplifiers of channel 1 are identical to those of channel 2 and accordingly only channel 1 is described.

The input signal is applied to SK A and then to the attenuator via the 3 position slide switch, S101. This allows the input signal to be directly coupled through in the DC position or coupled via C105 in the AC position. In the central GND position, the input signal from SK A is left open circuited while the input to the attenuator is grounded.

On the most sensitive ranges, 2mV/cm to 100mV/cm, the VOLTS/CM switch, S102 (201), couples the signal through directly to the pre-amplifier and the network resistor, R102c, provides the input impedance. On the remaining ranges, S102 (201) introduces R102a into the signal path to form a 100:1 attenuator with R102b in parallel with R102c.

High frequency compensation of the attenuator is provided by C101 and C104 while C102 with C106 allows the input capacitance of the attenuator to be set to equalise that of the unattenuated ranges.

Diodes, D201 and D202 with R207, provide input protection by limiting the input voltage applied to the amplifier to the voltages of zener diodes, D203 and D233.

The input stage of the pre-amplifier is formed by the f.e.t. source followers, TR201 and TR202, and emitter

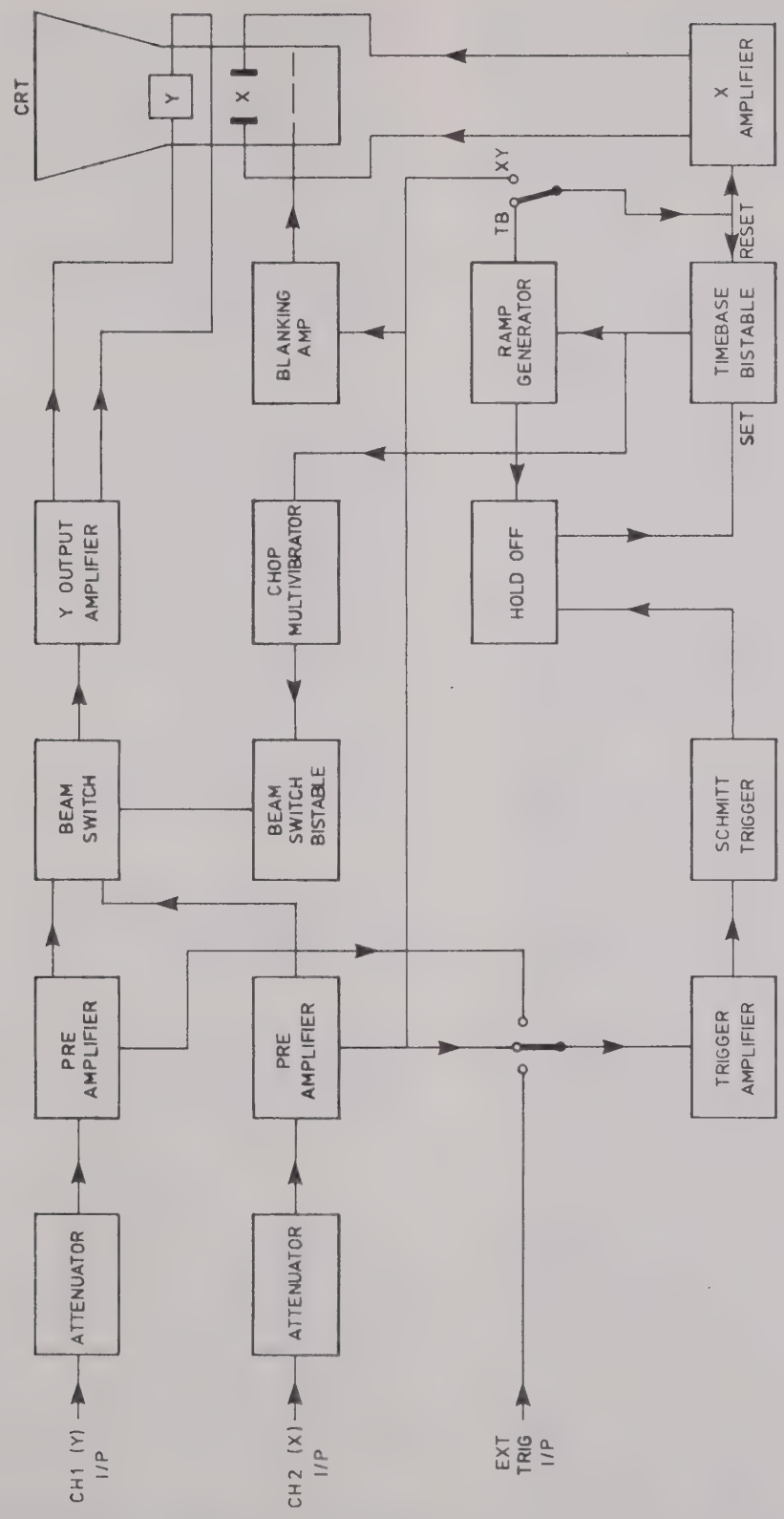


Fig. 1 Block Diagram

followers, TR204 and TR203. Unbalance in this stage is corrected by the BAL control potentiometer, R301.

The input stage drives the divider network, R209. The VOLTS/CM switch, S(102) 201, selects the necessary output, either directly via R209j on the 2mV or 200mV ranges, or attenuated by 2.5, 5, 10, 25 or 50 times on the subsequent ranges. This network presents a constant output impedance and further attenuation is introduced by the shunt action of the VARIABLE sensitivity control, R303. The resultant signal is amplified by the integrated amplifier, IC301. The amplifier gain is determined by R309 and the preset, R302. The differential output is balanced by the bias through R308 from the preset, R307.

The differential output from IC301 (CH1) or from IC351 (CH2) is selected by the beam switch as the input for the subsequent shunt feedback amplifier stage formed by TR401, TR402. The signal input currents are defined by R316 and R317 and are summed with the Y shift currents defined by R318 and R319 from the CH1 shift control, R315. The corresponding components for channel 2 are R366, R367, R368, R369 and R365. Channel 2 only differs from channel 1 by the addition of the double pole changeover switch, S301, which reverses the output signals from IC351 in the INVERT mode.

The beam switch is formed by the 8 diode gate, D301, D302, D303, D304, D351, D352, D353, D354. The relative control potentials from IC501 allow either the signal current from IC301 and/or IC351 to reach the bases of TR401 and TR402, or divert those currents from the bases.

The outputs from the differential shunt feedback amplifier stage formed by TR401 and TR402, are fed to the grounded emitter amplifier stage, TR403 and TR404. This in turn feeds the differential cascode Y output stage TR405, TR406, TR407 and TR408 to drive the Y deflection plates of the c.r.t.

High frequency compensation of the output amplifier is provided by networks between the emitters of TR403 and TR404 and those of TR405 and TR406. Adjustment of this compensation is by C402 and C405.

4.3 THE TRIGGER CIRCUITS

These circuits are shown in Fig. 3.

The Trigger Source switches, S502 and S503, connect the required trigger signal via the Trigger Coupling switches, S504 and S505, to the trigger buffer amplifier formed by TR601 and TR602. S502 selects the differential CH1 signal via R313 and R314 from IC301 (Fig. 2). S503 selects the equivalent CH2 signal via R363 and R364 from IC351. Where both S502 and S503 are selected, both of the above signals are disconnected and the single-sided input from the EXT TRIG input socket SKC is selected.

When the AC coupling switch, S504, is out, the trigger signals are directly coupled-through, but when this switch is in, AC coupling is introduced via C603 and C604 (C601 on External). TR601 and TR602 form a differential buffer amplifier with the DC balance controlled by the TRIGGER LEVEL control, R602. The differential output from this stage is applied to the comparator, IC602, which has positive feedback applied by R623 to form a Schmitt trigger circuit. The change-over switch, S506, reverses the output from TR601 and TR602 to determine the trigger slope.

When both S504 and S505 are "in" (AC and DC in for TV mode), the junction of R603 and C610 is connected to the − 11V supply. D601 and D608 are brought into conduction while D602 and D604 are reverse biased. This diverts the output of the trigger amplifier away from IC602, into TR605, which amplifies the positive tips of the video waveform only. TR605 is prevented from saturation by feeding back the peak detected synch. pulses via TR607 and TR606 to the emitter of TR605. These pulses are amplified by IC601b and applied via R617 and D603 to the Schmitt trigger, IC602. IC601a is used in conjunction with S504 and S505 to disable the synch. separator when AC or DC is selected.

At the fast timebase sweep speeds, S262a is open and TR603 is cut off. However at speeds of 100μs/cm and slower, R608 is connected to +11V and TR603 is switched on. This effectively grounds C609 to introduce an RC integrating time constant into the synch. pulse signal path in the TV mode to separate out frame trigger.

4.4 TIMEBASE GENERATOR AND X AMPLIFIER

The square wave trigger output from IC602 is applied (with d.c. bias of zener diode, D605) as the clock to the D type TTL flip-flop, IC501a. A positive-going trigger edge will clock the bistable, driving Q low. In the waiting state, $\bar{Q}$ was high (+4.5V), turning on TR261 via R507 and R262, holding the input, and hence the output, of the operational amplifier, IC261, at 0V. This timebase amplifier is connected as a direct voltage follower.

When the trigger signal sends $\bar{Q}$ of IC501a low, the timebase clamp transistor, TR261, is turned off. Part of the constant current generated by TR264 flows through the resistor network, R272, to charge C263 at a constant rate. The resultant positive-going linear ramp voltage generated at the input of IC261 is buffered by that amplifier to generate the low impedance ramp output.

The timebase range switch, S262, selects the tap point on the network, R272, to vary the ramp slope in the 1.2.5 sequence over a range of three decades. On all fast sweep ranges, TR262 is biased-off but on ramps 0.5ms/cm and slower, S262c connects R263 to +11V. TR262 is turned on and C264 is effectively connected in parallel with C263 to slow the sweep rate 1000 times.

The constant current into the ramp generator is derived from the current mirror circuit formed by TR263 and TR264. The variable gain control, R261, provides an approximate 3:1 range of variation in this current, R506 provides a preset calibration control on the slow sweep rates, only when S262 is closed.

When the ramp reaches its maximum level the negative bias, introduced by R521 and R519, is overcome and TR503 turns on, driving the reset input of the timebase bistable low. As the bistable switches, $\bar{Q}$ returns high and TR261 conducts to discharge the timing capacitor(s) and the sweep is complete. However, a hold-off action takes place to inhibit trigger signals during sweep and this remains for a short period after a sweep to ensure that the ramp potential is fully reset before the next sweep can be triggered. As the ramp goes positive, D506 conducts to charge C502, reverse biasing D503 and turning on TR502. At the end of sweep when the timebase bistable is reset, $\bar{Q}$ goes low and the D input follows via the action of D508 and R511. The ramp output returns rapidly toward 0V but TR502 remains in conduction for a period determined by C502 and R518. Only when TR502 turns off can R516 and D507 take the D input high for the bistable to respond to the next clock input.

TR501 acts in a way similar to TR262 (described above) to introduce additional hold-off time through C501 on the slower half of the timebase ranges.

The bright line facility causes the timebase to free-run in the absence of trigger signals. The square wave output from the Schmitt trigger, IC602, is coupled via C615 into the peak detector diodes, D606 and D607, to generate a positive-going signal into the –ve input of IC601c driving its output negative. In the absence of such trigger signals for a period determined by C618 with R627 and R626, the output of IC601c goes positive. When TR502 turns off at the end of the hold-off period, D509 conducts to turn on TR504, driving the set input low to initiate another sweep.

This free-run condition is removed as soon as IC601c detects an output from the Schmitt trigger. It can be inhibited also with a positive bias via R625 if the BRIGHT LINE OFF switch, S501, is operated.

The X output amplifier is formed by the shunt feedback stage of TR509/TR511 driving single sided into the amplifier stage, TR513 and TR514. The collector output of this stage drives the X deflection plates of the c.r.t. The gain introduced by TR509/TR511 is defined in the x5 magnification mode by the input resistance, R539, and the feedback resistance, R552, with the preset, R553. In this mode the transistor switch, TR512, is biased off. However in normal x1 magnification mode, S507 is open and the current in R548 turns on TR512, introducing R544 with preset, R551, as additional feedback to reduce the gain of the amplifier accordingly.

The X shift control, R501, introduces an additional bias input via R541 into the input of the shunt feedback amplifier.

4.5 MODE CONTROL CIRCUITS

The display mode is controlled by S261 (Fig. 3) which defines the state of three control lines according to the following table.

Mode	L1	L2	L3	Q	$\bar{Q}$
				IC501b	
X-Y	0	+11V	+11V	H	L
CH1	0	+11V	0	H	L
Dual	+11V	+11V	0	Switching	
CH2	+11V	0	0	L	H
Add	0	0	0	H	H

These lines in turn control the function of the beam switch and other necessary signal switching.

Section 4.3 describes the signal switching action of the beam switch diodes, D301 to D304 and D351 to D354. These are controlled by the Q and $\bar{Q}$ outputs of the beam switch bistable, IC501b. In the CH1 and X-Y modes l1 is open, allowing R525 to take the set input of the bistable low, Q is high and $\bar{Q}$ low, selecting the channel 1 signal for Y display. In the CH2 mode, L1 is at +11V and R514 takes the set input high but L2 is open and R524 takes the reset input low to reverse the bistable and select the channel 2 signal.

In the Add mode, both L1 and L2 are open so that both set and reset are applied to the bistable, Q and $\bar{Q}$ are high and both channel signals are added into the shunt feedback stage of the Y amplifier (Fig. 2). In this mode only, L1, L2 and L3 are open, removing the bias through D401, D402 or D403 and defined by R401 and R402 via D405 and D406. This offsets the additional bias introduced by the selection of both channel signals.

Only in the X-Y mode, L3 is held at +11V. This operates in the X output amplifier to turn on the transistor switch, TR506, so coupling the channel 2 pre-amplifier signal output of IC351 via R547 and D514 into the X output amplifier. At the same time D504 conducts to turn off the X5 gain switch transistor, TR512, selecting X5 magnification irrespective of the position of S507. D501 conducts allowing current through R509 to turn on TR261, clamping the ramp generator so that no signal is fed into the X amplifier via R539. Finally, current through R512 turns on TR504, holding the timebase bistable set "on" to provide continuous bright-up of the trace.

In the Dual mode, both L1 and L2 are held at +11V so that the beam switch bistable, IC501, is free of set of reset signals. Thus it can respond to clock signals and as its D input is connected to its Q output its state reverses on each clock input.

On the fast sweep ranges (0.2ms/cm and above), the clock input is derived via emitter follower, TR505, directly from the Q output of the timebase bistable. Thus the beam switch operates in the alternate modes. The Y deflection is switched between channels at the end of each sweep. TR507 and TR508 form a free-running emitter coupled multivibrator but on the above ranges, S262 – is open such that R534 is disconnected and the multivibrator is paralysed.

On the slow ranges (0.5ms/cm and below), R534 is connected to +11V and the multivibrator runs. During each sweep period, the multivibrator provides continuous clock inputs to the beam switch bistable so that the beam deflection signal is made to chop between the two channel signals. The beam switching is inhibited between sweeps as the emitter follower, TR505, clamps high the clock input to the beam switch bistable. In all modes but Dual, L1 or L2 are low and D512 or D513 conducts to inhibit the action of the multivibrator.

IC601d is used for the 1kHz calibrator. It is connected as an oscillator with positive feedback via R629 and negative feedback via R633. This with C617 defines the frequency as approx. 1kHz. The output is buffered by the transistor switch, TR604, which defines the calibrator output amplitude via the potential divider of R638 and R643 with preset, R641.

4.6 THE POWER SUPPLIES AND C.R.T. CIRCUITS

These circuits are shown in Fig. 4. The following d.c. supplies are generated in the power supply circuit from secondary windings on the supply transformer, T1.

+210V, +11V, +7V, −5V, −11V, −1850V.

The +210V line is used primarily in the X and Y output amplifiers. The −1850V line is the cathode supply for the c.r.t. In addition, a +5V line is generated in the time-base area from the +11V line by IC552 (Fig. 3).

The incoming a.c. supply from the supply connector, PLM, is switched by S1 and fused by FS1 before reaching the two supply range switches, S2 and S3. S2 connects the two primary windings of T1 in series or in parallel for 120V or 240V operation while S3 selects the necessary tap for 100V or 220V operation.

The output from the 210V secondary is bridge rectified by BR701 into the reservoir capacitor, C705. The resultant d.c. voltage, protected by FS701 feeds the h.t. regulator for the +210V supply. D728 is the reference for this supply, buffered by emitter follower, TR711, and the Darlington pair, TR713. The return of the rectified 210V supply is via the −11V line to balance load currents in the low voltage supplies.

The four low voltage supplies are derived from a single 25V secondary of transformer, T1. Its output is bridge rectified by BR702 into the reservoir capacitor, C704. The distribution with respect to the 0V line of the voltage across this capacitor is determined by the −11V shunt regulator and the +11V series regulator. The −11V reference is provided by the zener diode, D711, with temperature compensation diodes, D713 and D714, and the shunt transistor, TR712, conducts to maintain the −11V line at the correct potential.

The −5V line is derived from this −11V line by the zener diode, D712, with the compensation diode, D720, followed by the emitter follower, TR709.

With the negative side of the unstabilised supply across C704 defined at −11V by that stabiliser, the positive side is applied to the series regulator, IC702, which takes up all variation in the unstabilised supply to define the +11V line. This is a 15V regulator with 'low', pin 3, returned to a −4V potential defined from the −5V supply by R735 and R734.

The +7V supply is provided from the +11V supply by a further 12V series regulator, IC701, operating with respect to the −5V line.

All the above outputs are connected to the subsequent oscilloscope circuitry via split pads in the copper track pattern. These are normally bridged by solder but can be used to isolate each line to assist fault finding.

The grid and cathode supplies for the c.r.t. are derived via the voltage doubler circuit, D718, D719, C711 and C712, from the 950V secondary of T1. The negative side of the unstabilised supply developed across C711 and C712 is held at approx. −2000V with respect to 0V by the series zener diode, D706, which is returned to the stabilised cathode potential of −1850V. Subsequent variations in the unstabilised supply are developed across the series regulator, TR707, of the H.V. regulator. The feedback path of this regulator uses the current from the −1850V line defined by the R714, R715/R2 and R720e of the e.h.t. network. This current is returned to the +7V line via R731, R725 and R726. If the resultant potential of the tap point defined by the preset, R725, is not at approx. −4.5V, the current in transistor, TR708, will change to correct the stabilising voltage across TR707. TR708 and TR707 are connected in cascode.

The heater of the c.r.t. is supplied directly from an independent 6.3V secondary winding of T1.

The OS255 employs a novel modulation circuit to control the grid potential with respect to the cathode potential. The transistor pair, TR703 and TR704, generate an essentially constant current from the collector of TR703. This generates a constant voltage across R720d and preset, R713, and is returned to ground via the output of the bright-up amplifier. Thus signal variations from this amplifier which operates with respect to 0V are transferred with the large negative d.c. offset to the collector of R703, to be applied directly to the grid of the c.r.t. (pin 717) or via the emitter follower, TR716 (pin 733), if fitted.

In more detail, the constant current from TR703 is defined by the emitter resistance, R720c, and the base potential from the divider, R720 and R720a. This constant current source is returned to the −2000V line (negative of D706) so that the collector of TR703 (the c.r.t. grid) can move negative from the cathode. The collector potential is protected by D707 and D705 against excessive swing during switch-on or switch-off conditions. While R720d and R713 generate the necessary large d.c. potential to couple the bright-up signals to the grid, the high frequency components are by-passed through C702.

The bright-up signal amplifier is formed by the cascode transistor pair, TR701 and TR702, with shunt feedback

via R704. It responds to the sum of three inputs. The first is a d.c. bias via R707 from the INTENSITY control, R3. The second is the external Z Modulation signal from SKG, via R703. The third is the composite signal from the collector of TR507 (Fig. 3. See section 4.5), which provides bright-up during each timebase sweep with blanking of each chop transistor if appropriate. Diodes, D701 and D702, provide protection against excessive external inputs and with R702, prevent saturation of TR702.

The focus electrode of the c.r.t. is supplied from R2 with a portion of the −1850V supply. The astig. electrode is supplied from preset, R708, across the +210V supply.

Minor angular misalignment of the gun assembly of the c.r.t. or the effects of externally applied magnetic fields, axial to the c.r.t. can be corrected by the trace rotation coil. This coil is round the neck of the coil and the current is determined by the TRACE ROTATION control, R4, connected between the +11V supplies driving emitter followers, TR714 and TR715.

5.1 GENERAL

Figs. 3 and 4 show the internal location of the major components, sub-assemblies and preset controls. No regular maintenance is required but periodic recalibration may be necessary. The construction of the instrument is such that full access to all calibration controls and to most components can be obtained once the tubular case has been removed. Supply voltage adjustment is made by the two selector switches on the rear panel. The supply fuse is mounted adjacent to these switches and the supply connector. This connector should be removed or the instrument switched off before operating the switches. For 100 or 120V operation a 500mA, 20mm slo-blo fuse is required (Part No. 33685), for 200 or 220V operation a 250mA, 20mm slo-blo fuse is required (Part No. 33684). The internal H.T. fuse is a 100mA, 20mm fuse (Part No. 32958).

5.2 REMOVAL OF THE CASE AND SUB-ASSEMBLIES

(a) To remove the Case
DISCONNECT FROM THE SUPPLY.
Remove the two fixing screws on the side of the instrument, holding the carrying handle. Slacken the two fixing screws retaining the support stand. Remove the four fixing screws within the rear feet to remove the moulded rear cover. Withdraw the tubular cover.

WARNING
DANGEROUS VOLTAGES ARE EXPOSED ONCE THE CASE IS REMOVED. MAINTENANCE SHOULD BE CARRIED OUT ONLY BY QUALIFIED PERSONNEL. PARTICULAR CARE SHOULD BE TAKEN ON THE TUBE BASE AND IN THE H.V. AREA OF THE MAIN PRINTED BOARD WHERE VOLTAGES IN EXCESS OF 2000V ARE PRESENT.

(b) Removal of C.R.T.
Disconnect the trace rotation leads from the pins, 734 and 735, on the main board. Remove the tube base socket. Remove two tube base mounting screws (see Fig. 3) and withdraw the c.r.t. assembly from its front support moulding. Lift the assembly out, rotating it to clear the rear support clamp from the inner rear panel. Withdraw the tube from the shield. Remove the trace rotation coil if this is not integral with the tube.

When fitting a new tube, operate in the reverse order to that above but slacken the tube clamp screw. After tightening the two tube base mounting screws, ensure that the tube face is positioned against the graticule within the support moulding and push the tube shield forward before finally tightening the tube clamp screw.

Check the polarity of re-connection of trace rotation coil leads. Clockwise rotation of the front panel preset control should cause a corresponding movement of the trace.

NOTE: On early production instruments the pre-amplifier assembly cannot be removed as described. The initial operation of sub-section c must be carried out and then the front panel assembly removed as in sub-section d before the pre-amplifier assembly can be unplugged.

(c) Removal of the Pre-amplifier Board Assembly
Should it be necessary during repair to remove the pre-amplifier board for access to components on that board or on the front of the main board, proceed as follows.

Disconnect the two Y signal leads from the attenuator switches. Disconnect the ramp output lead to the front panel. Disengage the mode switch shaft and the trigger level pot shaft by pulling on both front panel knobs. Remove the three board mounting screws and the two switch mounting screws (see Fig. 3) and move the timebase switch mechanism forward to clear the wafer. Move the top of the pre-amplifier board gently backward to clear the attenuator switch shafts before unplugging the board from the main board.

On re-assembly, care should be taken for correct alignment of the switch wafers on the pre-amplifier board. A full section of rotor should be seen toward the bottom of the instrument when the timebase switch is in the fully anticlockwise position (0.2sec/cm). The gain switching wafers of the attenuator switch are symmetrical: either of the two alignment positions on the shaft may be used.

(d) Removal of the Front Panel Control Assembly
To obtain full access to the attenuator assemblies first remove the pre-amplifier assembly (c above). Remove the knobs from all the remaining control pots. All knobs use collet fixing to the shafts and the access to the screw or nut is obtained by prizing off the control cap.

Disconnect the External Trigger and Calibrator leads to the front panel assembly. Remove the four fixing screws holding the front panel to the frame and withdraw the frame assembly.

After removing the Volts/cm knobs, individual attenuator assemblies can be removed with the switch.

5.3 FAULT FINDING

Before any fault location is attempted, it is suggested that all supply voltages are checked. Subsequent signal voltages and waveforms should then be checked according to the following list, which may be used as a general guide and aid to servicing. Note that the typical voltages for unstablized supplies are quoted for nominal mid-range supply voltages.

Unless specified otherwise the front panel controls should be set as follows:

If a fault cannot be cleared it is recommended that the instrument is returned to the manufacturer for repair (see section 7).

When faults have been cleared it is recommended that the setting-up procedure of section 5.4 is followed.

Normal Operating Conditions
Unless otherwise specified the controls are set for single channel operation with the trace centred and timebase running. Potentials are specified with respect to ground and should be measured with a high impedance voltmeter, digital voltmeter or oscilloscope as appropriate.

a) Supplies

Unregulated

30V d.c. across C704 from 25V r.m.s. secondary voltage.

268V d.c. across C705 from 210V r.m.s. secondary voltage.

2.5kV d.c. across C711 and C712 from 960V r.m.s. secondary voltage.

Stabilised

+210V	±21V
+11V	±0.5V
+7V	+0.4V, −0.6V
−5.1V	+0.6V, −0.4V
−11V	±0.5V

Note: H.V. regulator should be set for collector of TR707 to be at +405V for nominal supply voltage.

b) Y Amplifier

Test Point	D.C. Level	Sensitivity
TR203/204 Collector	+7V	–
IC301, pin 1	+1V ±0.8V	–
IC301, pin 14	+1V ±0.8V	2mV/cm
IC301, pins 7, 8	+3.5V	65mV/cm each side
TR401/402 Collector	+3.7V	40mV/cm each side
TR403/404 Collector	+7.7V	140mV/cm each side
TR405/406 Collector	+12.6V	–
TR407/408 Base	+15.6V	–
TR407/408 Collector	+135V	6.8V/cm each side

c) Ramp Generator

Test Point	Signal
Across R265 or R266	0.8V d.c. at "cal" 0.3V d.c. at min.
IC261 pin 3 and pin 6	+3.7V ramp from 0.1V level
TR264 Collector	+3.7V ramp from base level between 0 and +4V dependent on sweep rate selected.

d) X Amplifier

Test Point	D.C. Level	Signal
TR512 Collector	+0.65V (Centre Screen)	500mV/cm 6.0V ramp
TR511 Emitter	+3.7V (Centre Screen)	500mV/cm 6.0V ramp
TR514 Base	−3.0V	–
TR513/514 Collector	+135V	12V/cm each side 140V ramp each side

e) Trigger Amplifier

Test Point	D.C. Level	Signal
TR601/602 Base	0V on Ext. 0V on Int. A.C. +3.5V on Int.D.C.	 65mV/cm each side 65mV/cm each side
TR601/602 Collector	−4.8V	25mV/cm each side

On TV mode:- TR601 and TR602 collector drops to between −8.5V and −10.5V dependent on the setting of the Trig. Level Control.

IC602, pin 9. Trigger output switches between −2V and −5.6V levels.

f) Timebase Control

Test Point	Signal
IC501, pin 14	+5V, ±0.25V
IC501, pin 1	+5V (+1V at end of ramp)
IC501, pin 2	+4V (0V during hold-off)
IC501, pin 3	Trigger pulses between −0.5V and +2.8V levels
IC501, pin 4	+5V (0V during reset by bright line)
IC501, pin 5	+0.2V between sweeps +4.5V during sweeps
IC501, pin 6	+4.5V between sweeps +0.2V during sweeps
IC501, pins 8, 9	Beam switched between +0.2V and +4.3V levels
IC501, pins 10, 13	−0.6V or 4.5V depending on mode switch setting
IC501, pin 11	Chop/alt. pulses between +0.2V and +4.7V levels
IC601, pin 8	+0.5V triggered or bright line off +0V bright line operating
IC601, pin 9	0V triggered or bright line off +9.5V bright line operating

g) Bright-Up Amplifier

Test Point	Signal
TR507 Collector	Switching signal +4.8V (blank) to 0V (Bright up)
TR702 Base	+2V
Collector	Between +6V and +48V dependent on intensity
R720, pin 2	2kV
R720, pin 3	+50V with respect to pin 2
R720, pin 5	+340V with respect to −1850V

5.4 SETTING-UP PROCEDURE

The following procedure details the adjustments necessary to recalibrate the OS255 and set all the preset controls to achieve the specified performance. Inability to make these adjustment or failure to meet the specification after those adjustments have been made should be considered as a fault and the operating conditions should be checked according to section 5.3.

The procedure should be followed in the specified order.

a. Test Equipment.

1. Multirange Test Meter including 2.5kV capability at 20kΩ/V.
2. Variable Autotransformer, output voltage 100–270V at 5A.
3. Sine/square wave signal generator, 10Hz to 100kHz, 20mV – 5V.
4. Source of voltage and time calibration signals.
5. Square wave generator, 500kHz, 100mV into 50Ω, rise time less than 50ns with square corner and flat top.
6. RF Sinewave, Constant Amplitude Signal Generator. 25mV to 5V pk/pk 50kHz to 15MHz.
7. 10:1 passive probe (PB12 or PB13).

b. Set High Voltage

Set the incoming a.c. supply via the auto-transformer to the nominal centre voltage of the selected range. Set to mid-brilliance on the c.r.t. Monitor the collector voltage of TR707. Adjust R725 for this voltage to be +405V ±5V. Remove the voltmeter. The instrument may now be operated directly from the uncontrolled supply.

c. Set Intensity Range

Set to X-Y mode with inputs grounded and centre the spot on the screen. Monitor the collector voltage of TR702. Adjust the Intensity control for this voltage to be +15V and then adjust R713 for the intensity of the spot to be near cut off. Remove the voltmeter.

d. Astigmatism

Display a mid-frequency sinusoidal signal in the normal sweep mode on one channel, approx.2cm pk to pk and 4cm period. Set the Variable sensitivity control fully anti-clockwise. Set to a fairly low brilliance and adjust both the Focus control and R708 (Astig.) for the sharpest trace over the whole of its length. Reset the Variable sensitivity to Cal.

e. Trace Rotation

Ground the input and set the horizontal trace to the centre line. Adjust the Trace Rotation preset control to align the trace with the centre graticule line.

f. Input Balance

Select CH1 and with the input grounded, adjust the preset Bal control for no vertical movement of the trace between the 0.1V/cm and the 0.2V/cm ranges. Repeat for CH2.

g. Trigger Balance

Set R357 for no vertical movement of the channel 2 trace when Invert is selected. Connect a sinusoidal input, AC coupled, to CH1 and set the trace for about 5cm pk to pk signal and one cycle displayed. Adjust R307 such that there is no change of trigger point as the Trigger Coupling is switched between AC and DC. Note that the relevant shift control may have to be operated to return the trace to the centre of the screen when R357 or R307 are adjusted.

h. Timebase Calibration

Ensure that the Variable Sweep is set fully clockwise to Cal. Apply 0.1ms calibrated time markers to either channel input. Set the timebase to 0.1ms/cm and obtain a centred triggered trace. Apply X5 Magnification and set R553 for 5cm spacing between the time markers.

Return to X1 Magnification and set R551 for 1cm spacing between markers.

Apply 1ms/cm time markers and set the timebase to 1ms/cm. Set R506 for 1cm spacing between the time markers.

All other timebase ranges can be checked for accuracy.

i. X-Y Calibration

Ensure that the CH2 Variable Sensitivity control is set fully clockwise to Cal. Select X-Y and apply a calibrated 100mV square wave to Channel 2 input. Select 20mV/cm. Ground channel 1. Set R352 for a 5cm horizontal trace length.

j. Channel 2 Calibration

Select CH2. With 100mV input at 20mV/cm as i. above, set R415 for a 5cm vertical amplitude signal.

All other sensitivity ranges can be checked for accuracy.

k. Ensure that the CH1 Variable Sensitivity control is set fully clockwise to Cal. Transfer the 100mV calibration signal to channel 1 and set to display that channel at 20mV/cm. Set R302 for a 5cm vertical amplitude signal.

All other sensitivity ranges can be checked for accuracy.

l. Attenuator Compensation

Apply a square wave input to CH1 at approx. 1V pk/pk and 1kHz. Select 0.2V/cm and adjust C101 on the CH1 attenuator assembly to obtain a square-topped displayed pulse.

Repeat for CH2.

m. Input Capacitance Equalisation

Select 100mV/cm on CH1 with the Variable Sensitivity control set fully anticlockwise and monitor a 10V 1kHz square wave via a 10:1 probe. Adjust the capacitive compensation of the probe for a flat-topped displayed pulse. Select 200mV/cm, reset the Variable Sensitivity to Cal and adjust C102 for a similar flat top to the pulse.

Repeat for channel 2.

n. Pulse Response and Bandwidth

Monitor a fast rise square wave input signal to examine the edge in detail on the 20mV/cm and 0.5μs/cm ranges.

Adjust C405 for a flat top following the transition and C402 for the optimum corner to the pulse.

Connect a constant amplitude sinusoidal generator and set the input for 6cm pk/pk at 50kHz. Increase the frequency and check that the loss of amplitude is less than 3dB at 15MHz (>4.2cm pk/pk).

o. Calibrator
Monitor a calibrated 1V pk/pk square wave input and set the sensitivity and variable sensitivity controls for a full 8cm pk/pk display. Disconnect the external input and connect the Y input to the OS255 Calibrator output. Adjust R641 for a similar 8cm signal amplitude.

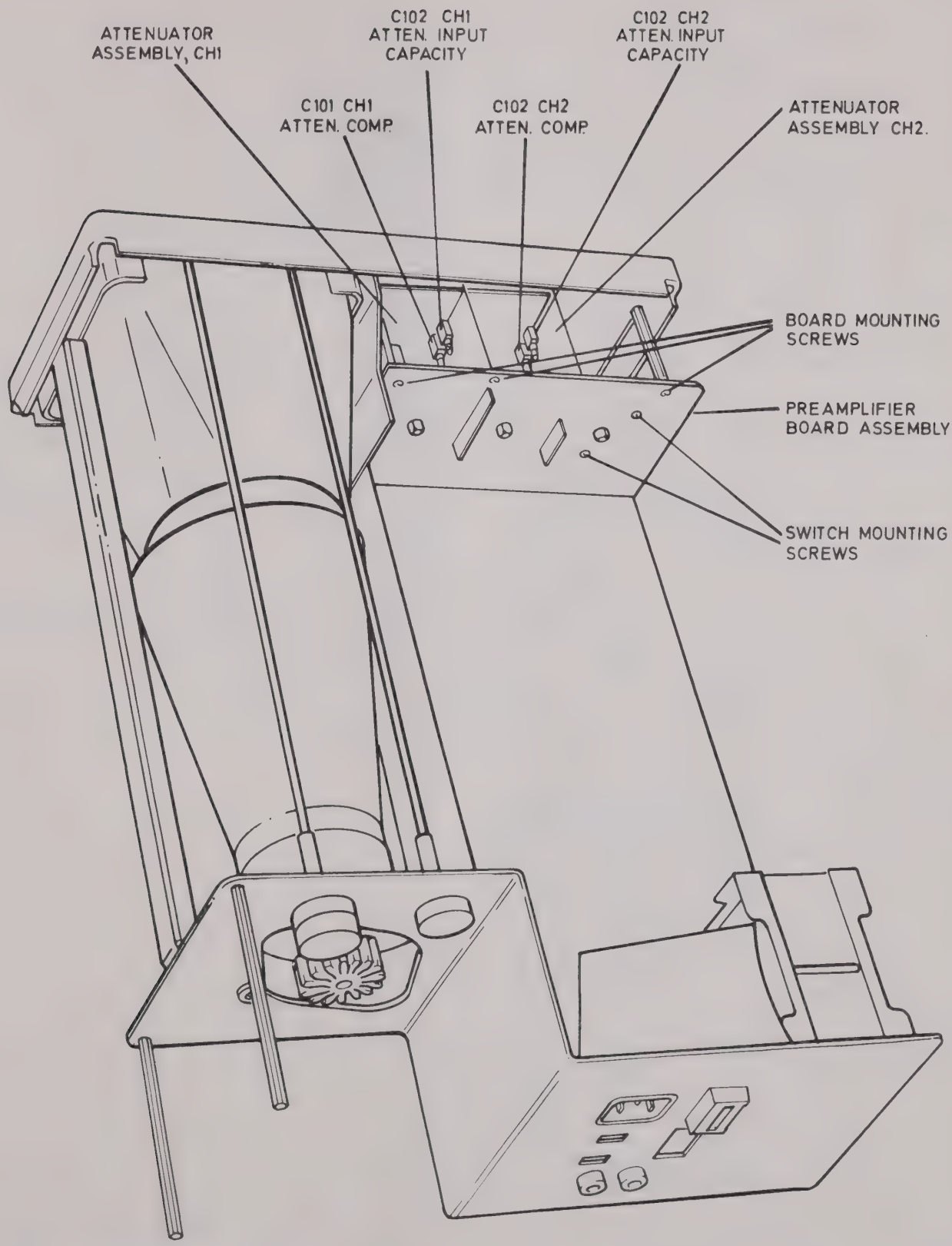


Fig. 2 Internal Assembly -- top view

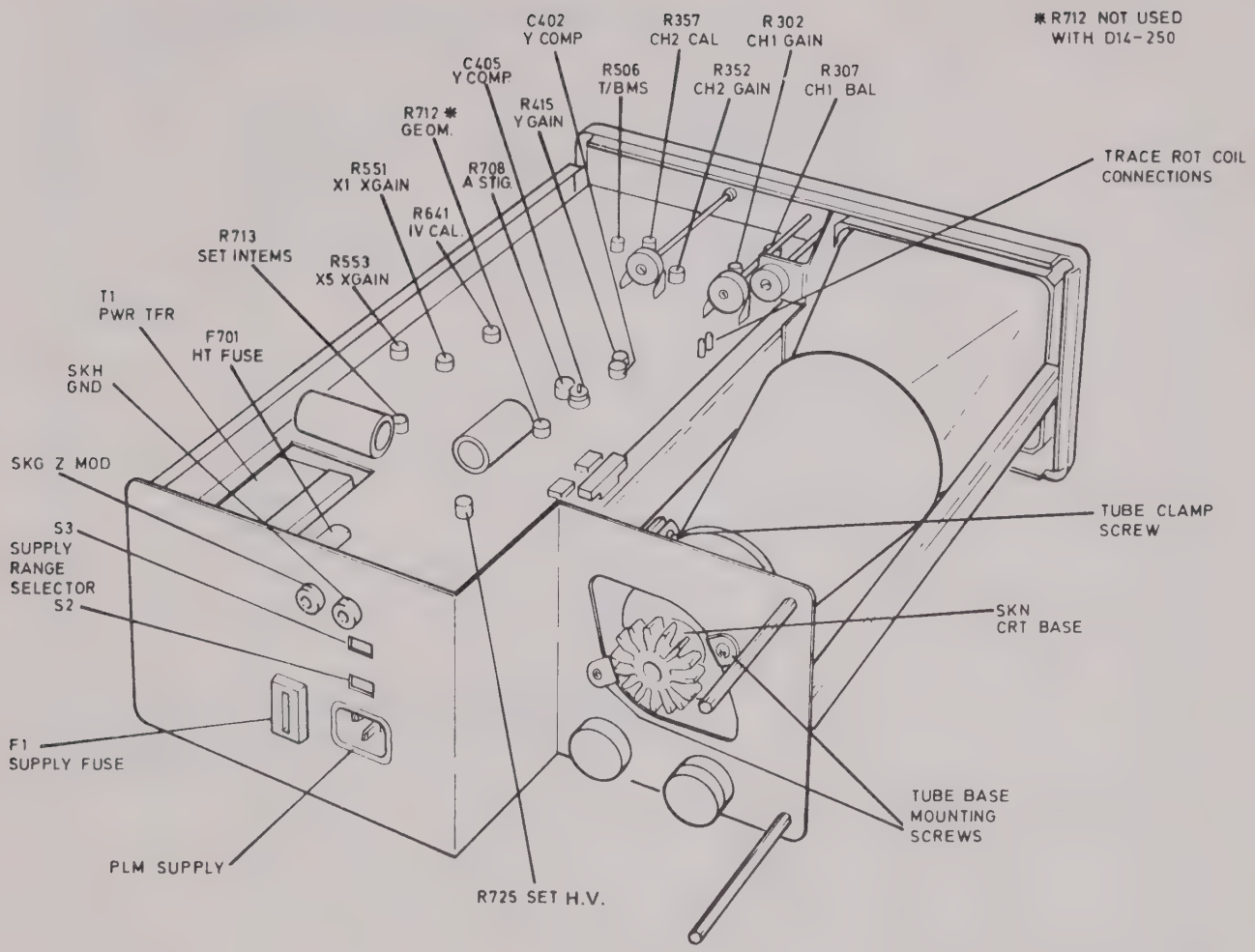


Fig. 3 Internal Assembly – bottom view

ABBREVIATIONS USED FOR COMPONENT DESCRIPTIONS

RESISTORS

CC	Carbon Composition	½W	10%	unless otherwise stated
CF	Carbon Film	⅛W	5%	unless otherwise stated
MO	Metal Oxide	½W	2%	unless otherwise stated
MF	Metal Film	¼W	1%	unless otherwise stated
WW	Wire Wound	6W	5%	unless otherwise stated
CP	Control Potentiometer		20%	unless otherwise stated
PCP	Preset Potentiometer Type MPD,PC		20%	unless otherwise stated

CAPACITORS

CE(1)	Ceramic		+ 80% - 25%	
CE(2)	Ceramic	500V	± 10%	unless otherwise stated
SM	Silver Mica			
PF	Plastic Film		± 10%	unless otherwise stated
PS	Polystyrene			
PE	Polyester		± 10%	unless otherwise stated
PC	Polycarbonate			
E	Electrolytic (aluminium)		+ 50% 10%	
T	Tantalum		+ 50% 10%	

NOTE: All part numbers shown in this manual shall be prefixed with AD2, i.e., 37898 should be AD237898.

OS255

Ref	Value	Description	Tol % ±		Part No
RESISTORS					
R1	100k	CF		1W	19061
R2	1M	CP			38707
R3	10k	CP With S1			38712
R4	4k7	CP			40548
R5	22	CF			28710
R6	22	CF			28710
R7	100k	CF			21819
R101	22	CF			28710
R102		Thick Film Network R102a-c			39381
R201	220	CF			21796
R202	10	CF			21793
R203	1k5	CF			21801
R204	1k5	CF			21801
R205	4k7	CF			21805
R206	47	CF			28714
R207	470k	CF	5	½W	04906
R208	470	CF			21797
R209					40038
R231	220	CF			21796
R232	10	CF			21793
R235	4k7	CF			21805
R236	47	CF			28714
R237	470k	CC	5	½W	04906
R238	470	CF			21797
R239		Resistor Network			40038
R261	10	CF			21793
R262	470	CF			21797
R263	4k7	CF			21805
R264	4k7	CF			21805
R265	1k	CF			21799
R266	1k	CF			21799
R267	10	CF			21793
R268	100	CF			21794
R269	47k	CP			38708
R272		Resistor Network			38692
R301	10k	PCP			38706
R302	100	CP			36958
R303	10k	CP			38710
R304	220	CF			21796
R305					
R306	1k	CF			21799
R307	47k	CP			38261
R308					
R309	180	CF			21795
R310					
R311	10	CF			21793
R312	10	CF			21793
R313	100	CF			21794

Ref	Value	Description	Tol % ±		Part No
R314	100	CF			21794
R315	4k7	CP			38709
R316	3k3	CF			21803
R317	3k3	CF			21803
R318	7k5	CF			40297
R319	7k5	CF			40297
R351	10k	PCP			38706
R352	100	CP			36958
R353	10k	CP			38710
R354	220	CF			21796
R355					
R356	1k	CF			21799
R357	47k	CP			38261
R358					
R359	180	CF			21795
R360					
R361	10	CF			21793
R362	10	CF			21793
R363	100	CF			21794
R364	100	CF			21794
R365	4k7	CF			38709
R366	3k3	CF			21803
R367	3k3	CF			21803
R368	7k5	CF			40297
R369	7k5	CF			40297
R401	2k2	MF	2		38602
R402	2k2	MF	2		38602
R403	2k2	MF	2		38602
R404	2k2	MF	2		38602
R405	2k7	MF	2		38604
R406	47	CF			28714
R407	2k7	MF	2		38604
R408	1k5	CF			21801
R409	1k5	CF			21801
R410	1k8	CF			28725
R411	1k8	CF	5	½W	18553
R412	390	CF			28722
R413	1k8	CF	5	½W	18553
R414	390	CF			28722
R415	100	CP			36958
R416	47	CF			28714
R417	180	CF			21795
R418	330	CF	5	½W	18544
R419	10	CF			21793
R420	10	CF			21793
R421	10	CF			21793
R422	330	CF	5	½W	18544
R423	120	CF			28718
R424	180	CF			21795
R425	150	CF			28719
R426	120	CF			28718
R427	120	CF			28718
R428	22	CF			28710
R429	27k	CF	5	½W	18567

OS255 Cont.

RESISTORS Cont.

Ref	Value	Description	Tol % ±	Part No
R430		Resistor Network R430a-b		40011
R431	27k	CF	5 ½W	18567
R432	22	CF		28710
R501	2k2	CP		40085
R502				
R503	470	CF		21797
R504	56k	CF		28729
R505	27k	CF		21813
R506	10k	PCP		39848
R507	4k7	CF		21805
R508	4k7	CF		21805
R509	33k	CF		21814
R510	10	CF		21793
R511	10k	CF		21809
R512	33k	CF		21814
R513	2k7	CF		28726
R514	1k5	CF		21801
R515	1k5	CF		21801
R516	1k	CF		21799
R517	22k	CF		21812
R518	22k	CF		21812
R519	12k	CF		21810
R520	2k2	CF		21802
R521	3k	CF		41399
R522	2k2	CF		21802
R523	4k7	CF		21805
R524	3k9	CF		21804
R525	3k9	CF		21804
R526	2k2	CF		21802
R527	680	CF		28723
R528	680	CF		28723
R529	1k	CF		21799
R530	56	CF		28715
R531				
R532	180	CF		21795
R533	1k2	CF		21800
R534	6k8	CF		21807
R535	1k	CF		21799
R536	10	CF		21793
R537	10	CF		21793
R538	10	CF		21793
R539	910	CF		28149
R540				
R541	2k4	CF		41400
R542	47	CF		28714
R543	12k	CF		21810
R542				
R543				
R544				
R545	10k	CF		21809
R548	8k2	CF		21808
R551	1k	CP		35880
R552	4k7	CF		21805
R553	4k7	PCP		35879
R554	680	CF		28723
R555	47	CF		28714
R556	2k7	CF		28726
R557	1k8	CF		28725
R558	10	CF		21793
R559	100	CF		21794
R560	220k	CF	5 ½W	18578
R561	100	CF		21794
R562	10k	CF		21809
R563	390	CF	5 ½W	18545
R564	33k	CF		21814
R565	33	CF		28712
R567	390	CF	5 ½W	18545
R568	10k	CF		21809
R569		Resistor Network		40014
R600	22k	CF		21812 *
R601	10k	CF		21809
R602	4k7	CP		38711
R603	3k3	CF		21803
R604	4k7	CF		21805
R605	2k2	CF		21802
R606	10k	CF		21809
R607	2k2	CF		21802
R608	4k7	CF		21805 *
R609	470	CF		21797 *
R610	10	CF		21793
R611	680	CF		28723
R612	680	CF		28723
R613	68k	CF		21816 *
R614	10	CF		21793
R615	12k	CF		21809
R616	470	CF		21797*
R617	2k7	CF		28726
R618	47k	CF		21815*
R619	3k3	CF		21803*
R620	1M	CF		31840*
R621	3k3	CF		21803*
R622	1k8	CF		28725
R623	220k	CF		21823
R624	10	CF		21793
R625	1M	CF		31840
R626	1M	CF		31840
R627	2M2	CF	5	40595
R628	3M9	CF		40326
R629	3M9	CF		40326
R630	100k	CF		21819*
R631	33k	CF		21814
R632	1M2	CF	10	40594
R633	15k	CF		28727
R634	6k8	CF		21807
R635	10	CF		21793
R636	68k	CF		21816*
R637	10k	CF		21809
R638	3k9	CF		21804

*** These part numbers used in S/N 1400 and higher. For earlier S/N's consult Gould service.**

OS255 Cont.

Ref	Value	Description	Tol % ±		Part No
RESISTORS Cont.					
R639	10k	CF			21809*
R640	39k	CF			28728
R641	2k2	CP			39488
R642	82k	CF	5	½W	18573
R643	470	CF			21797
R644	3k3	CF			21803*
R645	10k	CF			21809*
R701	1k	CF			21799
R702	680	CF			28723
R703	10k	CF	5	1W	02882
R704	22k	CF			21812
R705	5k6	CF			21806
R706	470	CF			21797
R707	5k6	CF			21806
R708	220k	CP			42042*
R709					
R710	2k2	CF			21802
R713	470k	CP			40441
R714	1M	CF			31840
R715	680k	CF			31839
R716					
R717	68M	MG	5		37173
R718	22k	CC	10	½W	03433
R719	18k	CF	5	½W	18565
R720		Resistor Network R720a-e			40012
R721					
R722	1k	CF			21799
R723	2k2	CF			21802
R724	5k6	CF			21806
R725	47k	CP			38261
R726	36k	MF	2		38631
R727	150	CF			28719
R728	100	CF			21794
R729	1k2	CF			21800
R730	820	CF	5	½W	18549
R731	3k3	CF			21803
R732	47k	CF			21815
R733	22k	CC	10	½W	03433
R734	68	CF			28716
R735	1k5	CF			21801
R736	1k	CF			21799
R737	470	CF	5	½W	18546
R738	470	CF	5	½W	18546
R739	47	CF	5	½W	18534
R740	2k7	CF	5	½W	18555
R741	2k7	CF	5	½W	18555
R742	220k	CF	5	½W	18578
CAPACITORS					
C1	2.2pF	S/M			00815
C101	6pF	Trimmer			29421
C102	6pF	Trimmer			29421

Ref	Value	Description	Tol % ±	Part No
C103	0.1μF	CE(2)	400V	29495
C104	680pF	PC	160V	40631
C105				
C106	6.8pF	CE(2)	500V	22362
C201	10μF	E	25V	32180
C202	.01μF	CE(2)	250V	22395
C203	.01μF	CE(2)	500V	24902
C204	1000pF	CE(2)	500V	22387
C231	10μF	E	25V	32180
C232	.01μF	CE(2)	250V	22395
C233	.01μF	CE(2)	500V	24902
C234	1000pF	CE(2)	500V	22387
C263	1200pF	PS	63V	37455
C264	1μF	PE	63V	31364
C265	.01μF	CE(2)	250V	22395
C266	0.1μF	CE(2)		36709
C267	.01μF	CE(2)	250V	22395
C301	.01μF	CE(2)	250V	22395
C302	.01μF	CE(2)	250V	22395
C303	2.2pF	CE(2)		36598
C351	.01μF	CE(2)	250V	22395
C352	.01μF	CE(2)	250V	22395
C401	.01μF	CE(2)	250V	22395
C402	10/40pF	Trimmer		29483
C403	22pF	CE(2)	500V	22368
C404	150pF	S/M		04514
C405	10/65pF	Trimmer		30286
C406	82pF	CE(2)		22375
C407	0.1μF	CE(2)		36709
C411	.01μF	CE(2)	500V	24902
C412	22pF	CE(2)	500V	22368
C501	.22μF	PE	250V	39201
C502	1000pF	CE(2)	500V	22387
C503	.01μF	CE(2)	250V	22395
C504	.01μF	CE(2)	250V	22395
C505				
C506	10pF	CE(2)	500V	22364
C507	.01μF	CE(2)	250V	22395
C508	.01μF	CE(2)	250V	22395
C509	.01μF	CE(2)	250V	22395
C510	560pF	CE(2)	500V	22384
C511	3300pF	CE(2)	500V	22391
C512	.01μF	CE(2)	500V	24902
C513	0.1μF	CE(2)		36709
C514	680pF	PS		35917
C515	27pF	CE(2)	500V	22369
C520	10μF	E	25V	32180

*** These part numbers used in S/N 1400 and higher. For earlier S/N's consult Gould service.**

OS255 Cont.

Ref	Value	Description	Tol % ±	Part No
CAPACITORS Cont.				
C601	.22µF	PE	250V	39201
C602	100pF	CE(2)	500V	22376
C603	2.2µF	E	63V	32194
C604	2.2µF	E	63V	32194
C605	22pf	CE(2)	500V	22368 *
C606	0.1uf	CE(2)		36709
C607	0.22uF	PE	250V	39201 *
C608	0.01uF	CE(2)		22395 *
C609	0.1uF	CE(2)		36709 *
C610	.01uF	CE(2)	250V	22395
C611	22pF	CE(2)	500V	22368 *
C612	0.1uF	CE(2)		36709
C613	.01uF	CE(2)	250V	22395
C614	47pF	CE(2)		22372 *
C615	0.1µF	CE(2)		36709
C616	.01µF	CE(2)	250V	22395
C617	.047µF	PE	250V	39197
C618	.022µF	CE(2)		02663
C619	100pF	CE(2)	500V	22376
C701	.01µF	CE(2)	250V	22395
C702	5000pF	CE(1)	3kV	01514
C703	5000pF	CE(1)	3kV	01514
C704	1000µF	E	40V	40344
C705	33µF	E	350V	40343
C706	100pF	CE(2)	500V	22376
C707	.22µF	PE	250V	35602
C708	10µF	E	25V	32180
C709	5000pF	CE(1)	3kV	01514
C710	10µF	E	25V	32180
C711	0.1µF	PE	1500V	40075
C712	0.1µF	PE	1500V	40075
C713	.22µF	PE	250V	39201
C714	.01µF	CE(2)	250V	22395
C715	.22µF	PE	250V	39201
C716	.01µF	CE(2)	250V	22395
C717	.22µF	PE	250V	39201
TRANSISTORS				
TR201, TR202		AE35 Dual F.E.T.		40062
TR203, TR204		AE13 Matched Pair		31254
TR231, TR232		AE35 Dual F.E.T.		40062
TR233, TR234		AE13 Matched Pair		31254
TR261		2N2369 ITT Only		33701
TR262		2N3904		24146
TR263		BC214C		36019
TR264		BC214C		36019
TR401		MPS2369		36625
TR402		MPS2369		36625

Ref	Value	Description	Tol % ±	Part No
TR403		MPS2369		36625
TR404		MPS2369		36625
TR405		PN2369		40320
TR406		PN2369		40320
TR407		BF468		40056
TR408		BF468		40056
TR501		2N3904		24146
TR504		2N3904		24146
TR505		2N3904		24146
TR506		2N3904		24146
TR507		2N3906		21533
TR508		2N3906		21533
TR509		BC182B		33205
TR510				
TR511		2N3904		24146
TR512		2N3906		21533
TR513		NSD459		40054
TR514		NSD459		40054
TR601		BC214C		36019
TR602		BC214C		36019
TR603		2N3904		24146
TR604		2N3906		21533
TR605		2N3904		24146 *
TR606		2N3904		24146 *
TR607		2N3906		21533 *
TR701		2N2369	ITT Only	33701
TR702		92PU391		40055
TR703		92PU391		40055
TR704		BC214C		36019
TR705				
TR706		BC182B		33205
TR707		MJE13003	Selected	40433
TR708				
TR709		BC328		38414
TR710				
TR711		BC214C		36019
TR712		TIP29A		38419
TR713		TIP112		40591
TR714		BC547		40546
TR715		BC557		40547
TR716		2N6518		36472
DIODES				
D1		L.E.D.		39884
D201		1N3595		29330
D202		1N3595		29330
D203	6V8	ZENER		33931
D231		1N3595		29330
D232		1N3595		29330
D233	6V8	ZENER		33931
D301		1N4148	FAIRCHILD	34701
D302		1N4148	FAIRCHILD	34701

*** These part numbers used in S/N 1400 and higher. For earlier S/N's consult Gould service.**

OS255 Cont.

Ref	Value	Description	Tol % ±	Part No
DIODES Cont.				
D303		1N4148	FAIRCHILD	34701
D304		1N4148	FAIRCHILD	34701
D351		1N4148	FAIRCHILD	34701
D352		1N4148	FAIRCHILD	34701
D353		1N4148	FAIRCHILD	34701
D354		1N4148	FAIRCHILD	34701
D401		1N4148		23802
D402		1N4148		23802
D403		1N4148		23802
D404	5V1	ZENER		33928
D405		1N4148		23802
D406		1N4148		23802
D501		1N4148		23802
D502		1N4148		23802
D503		1N4148		23802
D504		1N4148		23802
D505		1N4148		23802
D506		1N4148		23802
D507		1N4148		23802
D508		1N4148		23802
D508		1N4148		23802
D509		1N4148		23802
D510		1N4148		23802
D511		1N4148		23802
D512		1N4148		23802
D513		1N4148		23802
D514		1N4148		23802
D515		1N4148		23802
D516		1N4148		23802
D517		1N4148		23802
D518		1N4148		23802
D519		1N4148		23802
D520				
D521	6V2	ZENER		33930
D601		1N4148		23802
D602		1N4148		23802
D603		1N4148		23802
D604		1N4148		23802*
D605	5V1	ZENER		33928
D606		1N4148		23802
D607		1N4148		23802
D608		1N4148		23802*
D609	47V	ZENER		40049
D610		1N4148		23802*
D611		1N4148		23802
D701		1N4148		23802
D702		1N4148		23802
D703		1N4148		23802
D704	47V	ZENER		40049*
D705		1S923		03560
D706	150V	ZENER		37559
D707		1S923		
D708		1N4148		23802
D709	200V	ZENER		40052
D710				
D711	9V1	ZENER		04667
D712	5V1	ZENER		33928
D713		1S923		03560
D714		1S923		03560
D715	200V	ZENER		40052
D716	200V	ZENER		40052
D717	200V	ZENER		40052
D718		HS2-4		35278
D719		HS2-4		35278
D720		1N4148		23802
D721		1S923		03560
D728	200V	ZENER		40052
INTEGRATED CIRCUITS				
IC261		LF351N		40130
IC301		LM733CN		40084
IC351		LM733CN		40084
IC501		74LS74N		36732
IC552		LM78L05 ACZ		40406
IC601		MC3401P		40061
IC602		LM710CN		40083
IC701		MC78L12 ACP		40060
IC702		LM341P15		40059
MISCELLANEOUS				
BR701		W04		29367
BR702		W04		29367
V1		Mullard D14-250GH	Normal Version	40416
OR		Mullard D14-250GM	Long Persistence	40417
L403		Ferrite Bead FX1242		26986
T1				38696
SWITCHES				
S1		With R3		38712
S2				04069
S3				04069
S101				39854
S102				40016
S201				40048

*** These part numbers used in S/N 1400 and higher. For earlier S/N's consult Gould service.**

OS255 Cont.

Ref	Value	Description	Tol % ±	Part No
SWITCHES Cont.				
S231				40048
S261				39865
S262				40278
S301				38729
S501-506				38728
S507				38729
SKA				01222
SKB				01222
SKC				01222
SKD				40076
SKE				40076
SKF				24159
SKG				40076
SKH				40076
SKJ				40072
SKK				40072
SKL				40072
PLJ				40073
PLK				40073
PLL				40073
PLM				33787
F1	250mA	250V Supply		33684
OR	500mA	110V Supply		33685
F701	100mA			32958

REF S	R5 RE	R101	R102a,b,c	R207 R237	R203	R204	R201 R208 R209a-o R231 R238 R239a-o	R202 R232	R206 R233	R205 R235	R331	R306 R304 R303 R356 R351 R353 R354	R309 R302 R359 R352	R308 R358 R364	R307 R357	R314 R363 R361	R311	R313 R316 R317 R366 R367	R318 R368	R315 R365 R362	R319 R369	R419	R312	R401 R405	R408 R403	R414 R406 R413	R417	R410 R412 R415 R416	R411	R409	R404	R402 R407	R426 R422 R421	R428 R423 R425	R430b R431 R429 R424	R427	R420 R432 R418
CAP		C103	C102 C101 C104 C105 C106			C203 C233		C202		C201 C231	C232	C204 C234		C301	C302 C352	C351												C403 C402		C401					C411 C406	C407	C404		
MISC	SKA SKB		S101	S102		D201 D202 D203 D282 D231 D233		TR201 TR231	TR204 TR234	TR203 TR233	TR202 TR232	S201	PLJ/SKJ	IC301 IC351		S301				D302 D301 D352 D351		D303 D304 D353 D354		D405	TR402 TR404	D401	D402	D403	TR403	TR401 D406		TR407 L401		D404			R408 L402		

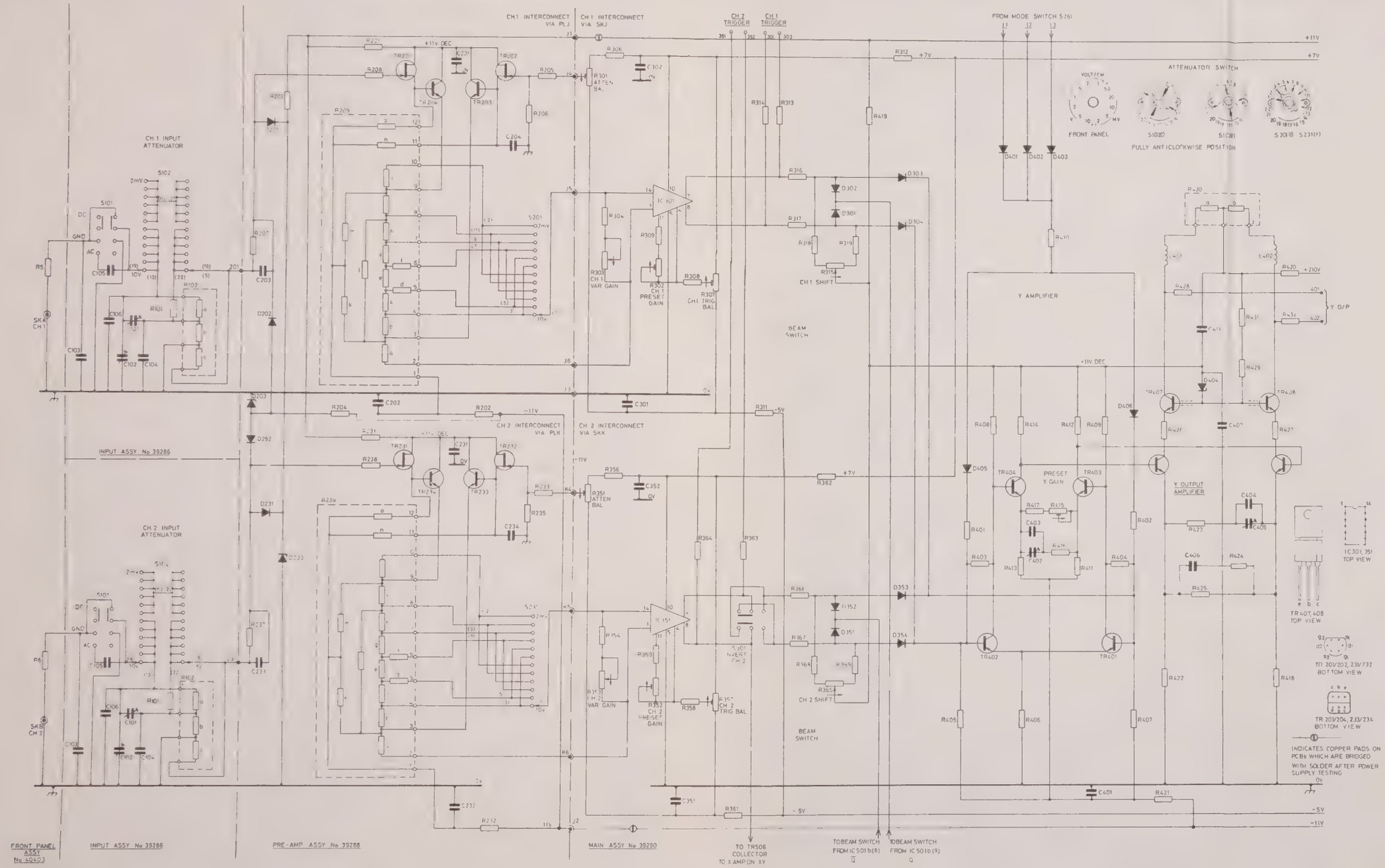
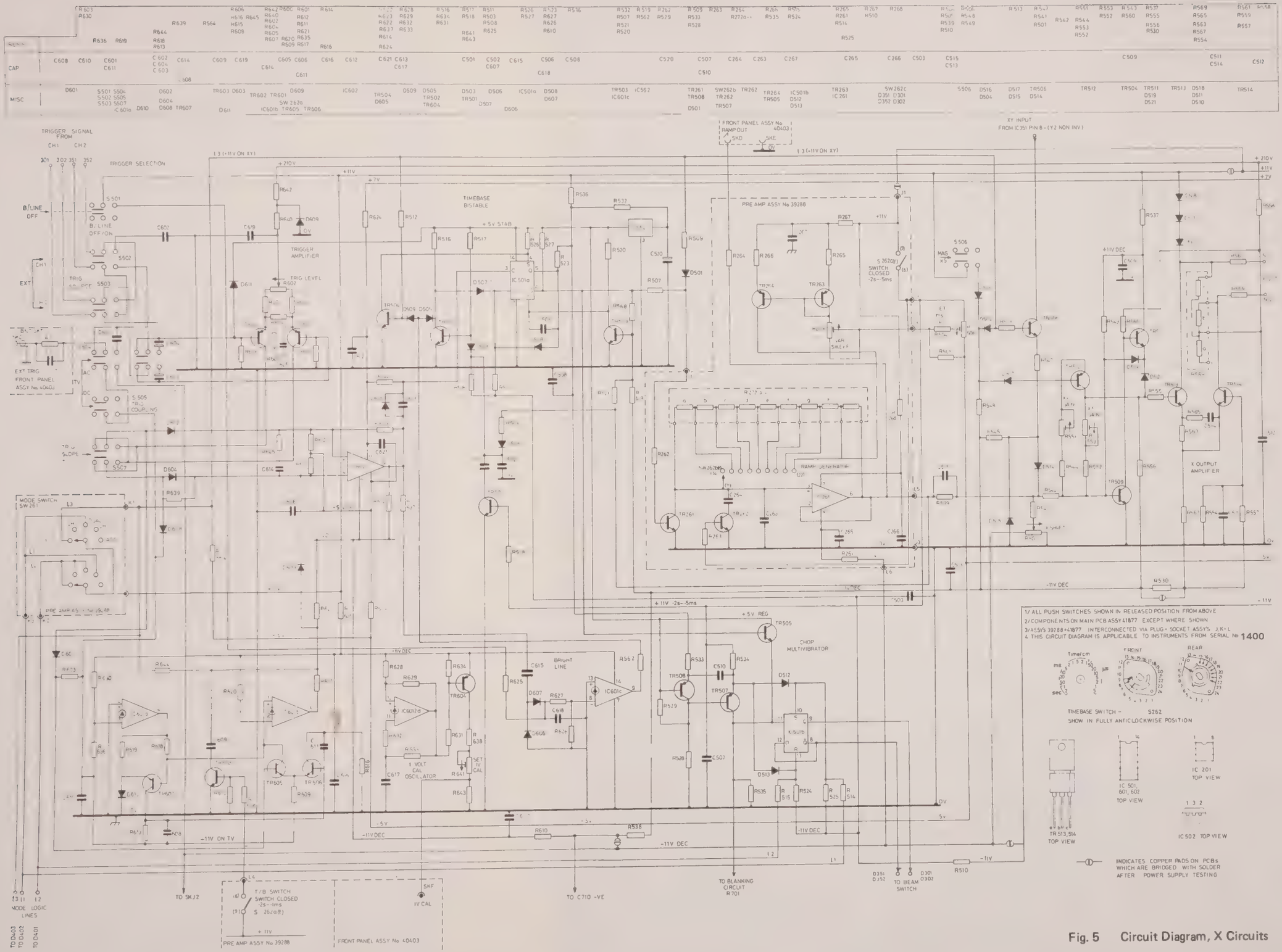


Fig. 4 Circuit Diagram, Y Amplifier



1/ ALL PUSH SWITCHES SHOWN IN RELEASED POSITION FROM ABOVE
2/ COMPONENTS ON MAIN PCB ASSY 41877 EXCEPT WHERE SHOWN
3/ ASSYS 39288+41877 INTERCONNECTED VIA PLUG + SOCKET ASSYS J, K + L
4 THIS CIRCUIT DIAGRAM IS APPLICABLE TO INSTRUMENTS FROM SERIAL No **1400**

Fig. 5 Circuit Diagram, X Circuits

Fig. 6 Circuit Diagram, Power Supply and C.R.T. Circuits

1	Frame	40312
2	Front Panel Inner	40310
3	Escutcheon	38399
4	Coverlay, Excutcheon	40404
5	Coverlay, Front Panel	40405
6	Stand	40418
7	Foot, LH	38402
8	Foot, RH	40425
9	Support, Side (Long)	40376
10	Support, Side (Short)	40389
11	Panel, Rear	40313
12	Spacer	40430
13	Screen	40686
14	Connector, Supply	33787
15	Fuse Holder	40068
16	Screen	40308
17	Heatsink	40307
18	Clamp C.R.T.	40375
19	Case	40377
20	Foot, Rear	36329
21	Moulding, Rear	40304
22	Handle, Fittings	24834
23	Handle	40424
24	Screw M4 x 20 Pan Hd.	33048
25	Screw M4 x 10 Pan Hd.	33045
26	Washer M4 Plain	33004
27	Washer M4 Wavey	33017
28	Spacer	40339
29	Screw M3 x 8 Pan Hd.	33038
30	Screw M3 x 20 Pan Hd.	33042
31	Washer Wavey M3	33016
32	Screw M3 x 5 Pan Hd.	33036
33	Screw M3 x 10 Pan Hd.	33039
34	Screw Taptite M3 x 10 Pan Hd.	33096
35	Screw M3 x 6 C'sk Hd.	33068
36	Rivet, Pop	11557
37	Screw M2 x 5 C'sk Hd.	33118
38	Screw M2.5 x 6 Pan Hed.	33032
39	Washer Wavey M2.5	33015
40	Knob, Push Button	38407
41	Bezel	38408
42	Socket B.N.C.	01222
43	Socket 4mm	40076
44	Switch, Slide	39854
45	Terminal	24159
46	L.E.D.	39884
47	Knob 14mm Dia.	40794
48	Cap (14mm)	40589
49	Knob 21mm Dia.	40410
50	Cap (21mm)	40412
51	Knob 10mm Dia. Winged	40579
52	Knob 10mm Dia.	40580
53	Knob 10mm Dia	40408
54	Cap (10mm)	40411

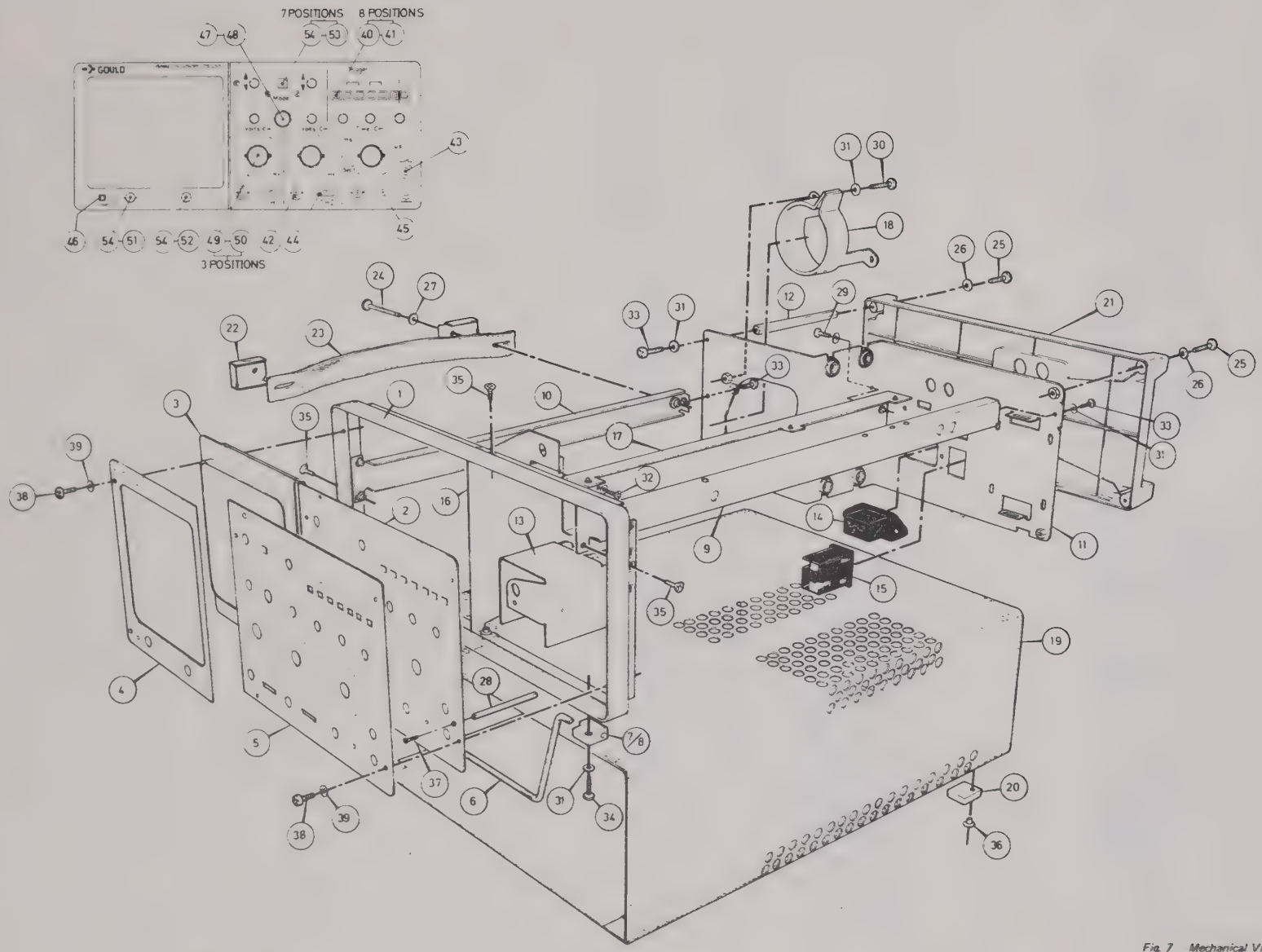


Fig. 7 Mechanical Views

Warranty and Service Facilities

Section 7

Gould Oscilloscopes are warranted for a period of two years from date of shipment to original purchaser. They are warranted to conform to the applicable published specifications in effect at the time of shipment, and to be free from any defects in material or workmanship.

LIABILITY OF THE GOULD INSTRUMENTS DIVISION UNDER SUCH WARRANTY IS LIMITED TO SERVICING OR REPLACING DURING THE WARRANTY PERIOD AT THEIR OPTION, ANY DEFECTIVE PARTS EXCEPT COVERS, PROBES OR FUSES AND DOES NOT INCLUDE CALIBRATION AND MINOR MAINTENANCE AS OUTLINED IN OPERATING MANUALS. IN NO EVENT SHALL THE GOULD INSTRUMENTS DIVISION BE LIABLE FOR COLLATERAL OR CONSEQUENTIAL DAMAGES.

Units are to be returned transportation prepaid by the buyer. The Gould Instruments Division will have the right of final determination of the cause and existance of a defect under this warranty. This warranty shall not apply to any products which have been subjected to misuse, improper installation, repair, alteration, neglect, accident, inundation, fire or operation outside their published maximum ratings.

PACKING INFORMATION

If the unit is to be returned for service, it must be adequately packed as follows:

a) Seal the unit in an oversize plastic bag.

b) Pack the bagged unit into a heavy duty cardboard box. The box must have a minimum of 2 inches of cushioning on all six sides, so that the unit fits snugly.

c) Any accessories or instruction manuals must be sealed into a separate plastic bag and packed with a minimum of 2 inches of cushioning between the instrument and the accessories.

d) Before sealing the box with packing tape, ensure that an official packing note is inserted, giving full details of sender's name, address and telephone number, instrument type number and serial number, plus an indication of the reason for return, and/or fault conditions, if applicable.

e) Properly label and address the outside of the box.

f) Notify Gould in advance of shipment and ship prepaid by United Parcel Service or equivalent.

Service Centers

EAST

Boston, MA
Branch and Regional Office
129 Middlesex Turnpike
Burlington, Massachusetts 01803
Phone: (617) 2720

Huntsville, AL
W. A. Brown Instruments, Inc.
7917-C Charlotte Drive
Huntsville, AL 35802
Phone: (205) 883-8660
TWX: 810-726-2114

Orlando, FL
W. A. Brown Instruments, Inc.
222 Weber Street
Orlando, FL 32803
Phone: (305) 425-5505
TWX: 810-850-0146

Philadelphia, PA
Branch Office
G.S.B. Bldg.
Belmont & City Line Ave.
Bala Cynwyd, PA 19004
Phone: (215) 839-7066

Pittsburgh, PA
Campbells Run Road
Parkway West
Pittsburgh, PA 15205
Phone: (412) 923-2160

Saddle Brook, N.J.
Branch Office
74 Kenney Place
Saddle Brook, New Jersey 07662
Phone: (201) 845-0220
TWX: 710-990-5091

Washington, DC
Branch Office
5900 Princess Garden Parkway
Lanham, MD 20801
Phone: (301) 459-7350

CENTRAL

Chicago, IL
801 Mark Street
Elk Grove Village, Illinois 60007
Phone: (312) 640-4380

Cleveland, OH
Branch and Regional Office
3631 Perkins Avenue
Cleveland, OH 44114
Phone: (216) 361-3315
TWX: 810-421-8580

Dayton, OH
4668 Gateway Circle
Dayton, Ohio 45429
Phone: (513) 433-9586

Detroit, MI
23775 Northwestern
Southfield, Michigan 48075
Phone: (313) 355-0900

Houston, TX
10500 Northwest Freeway
Houston, Texas 77092
Phone: (713) 680-1121

WEST

San Francisco, CA
4600 Old Ironside Drive
Santa Clara, California 95050
Phone: (408) 988-8871

Denver, CO
730 West Hampden Avenue
Englewood, Colorado 80110
Phone: (303) 761-7021

Los Angeles, CA
2525 Campus Drive
Irvine, California 92715
Phone: (213) 639-7301

Seattle, WA
Branch Office
The Common Building
Suite C155
1200 112 Avenue, N.E.
Bellevue, WA 98004
Phone: (206) 453-8100

Gould Inc., Instrument Division
3631 Perkins Avenue, Cleveland, Ohio 44114
Telephone (216) 361 3315

www.manualsplus.com
1026547

Gould Inc., Instruments Division
3631 Perkins Avenue, Cleveland, Ohio 44114
Telephone (216) 361-3315

GOULD
An Electrical/Electronics Company